

FIGURE 1 *(Prior Art)*

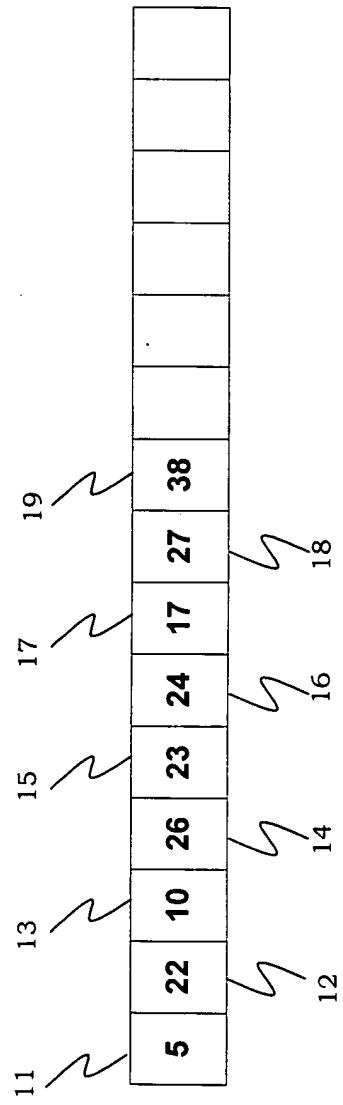


FIGURE 2
(Prior Art)

A) The value in the root node is removed, leaving a "hole".

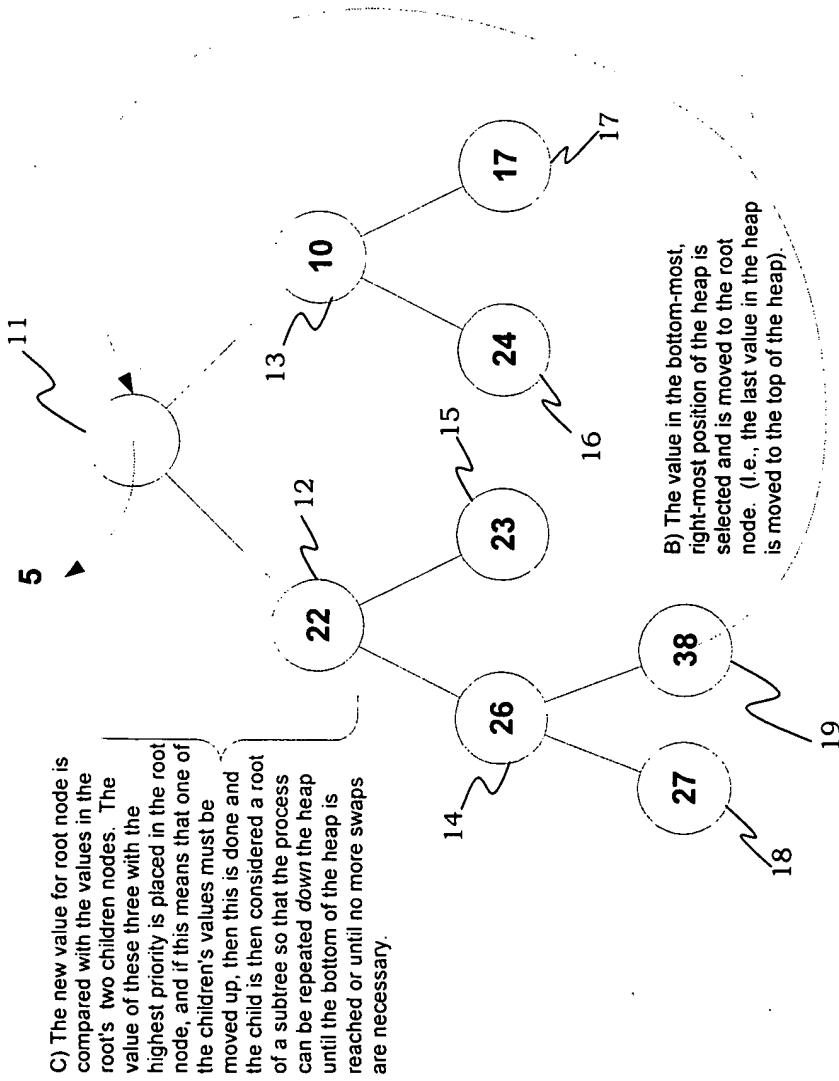


FIGURE 3
(Prior Art)

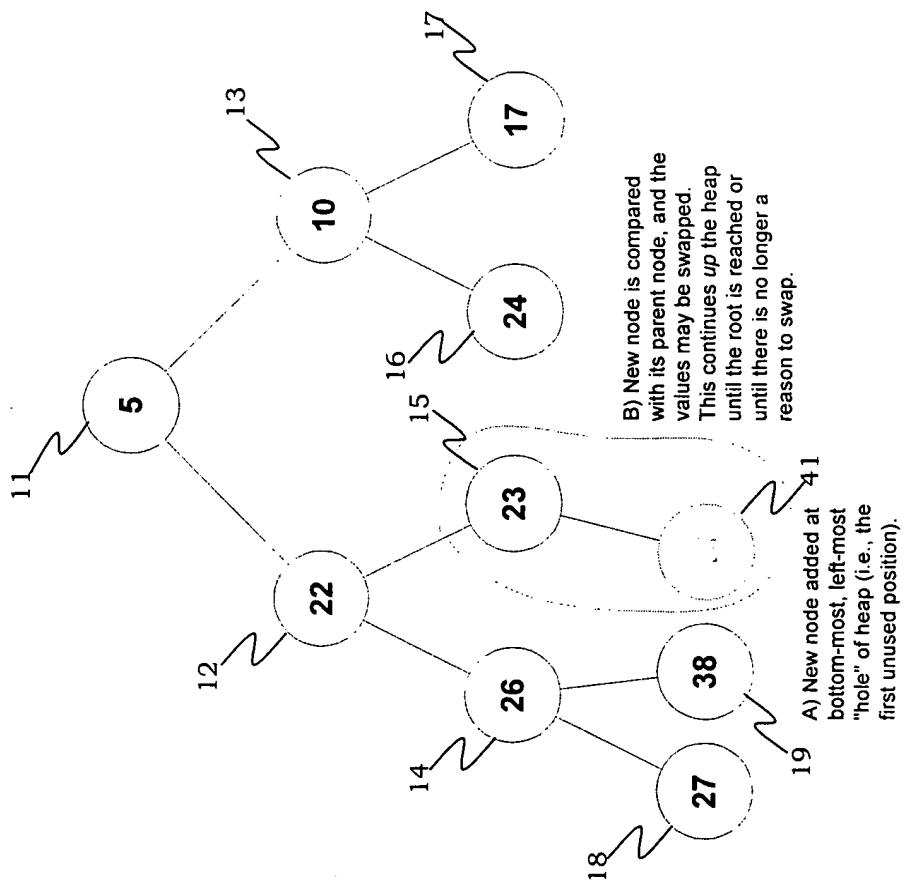
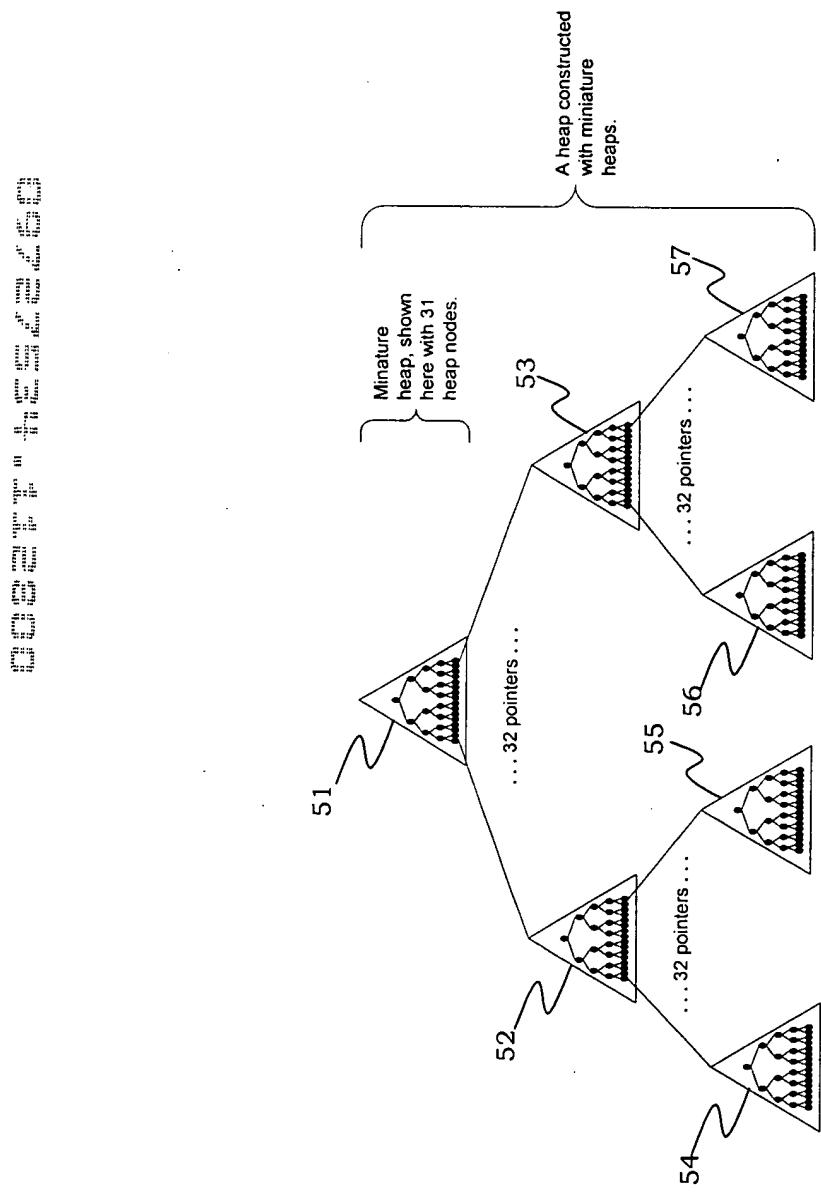


FIGURE 4
(Prior Art)

FIGURE 5



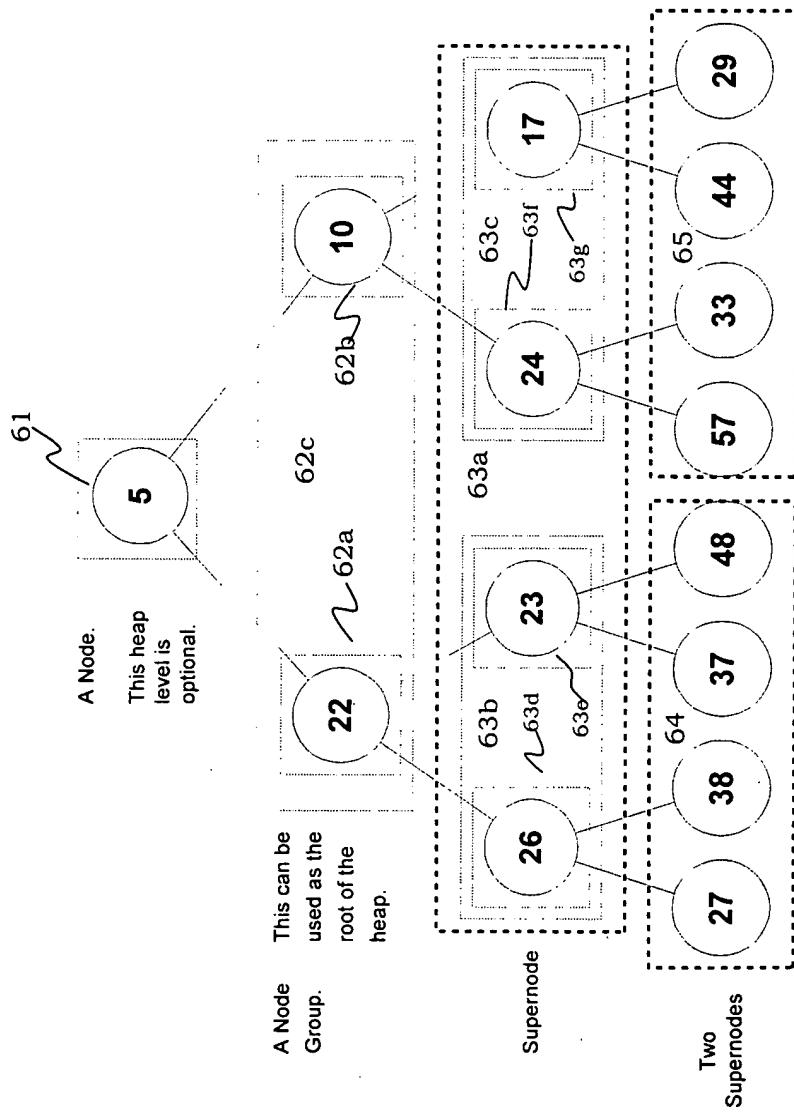
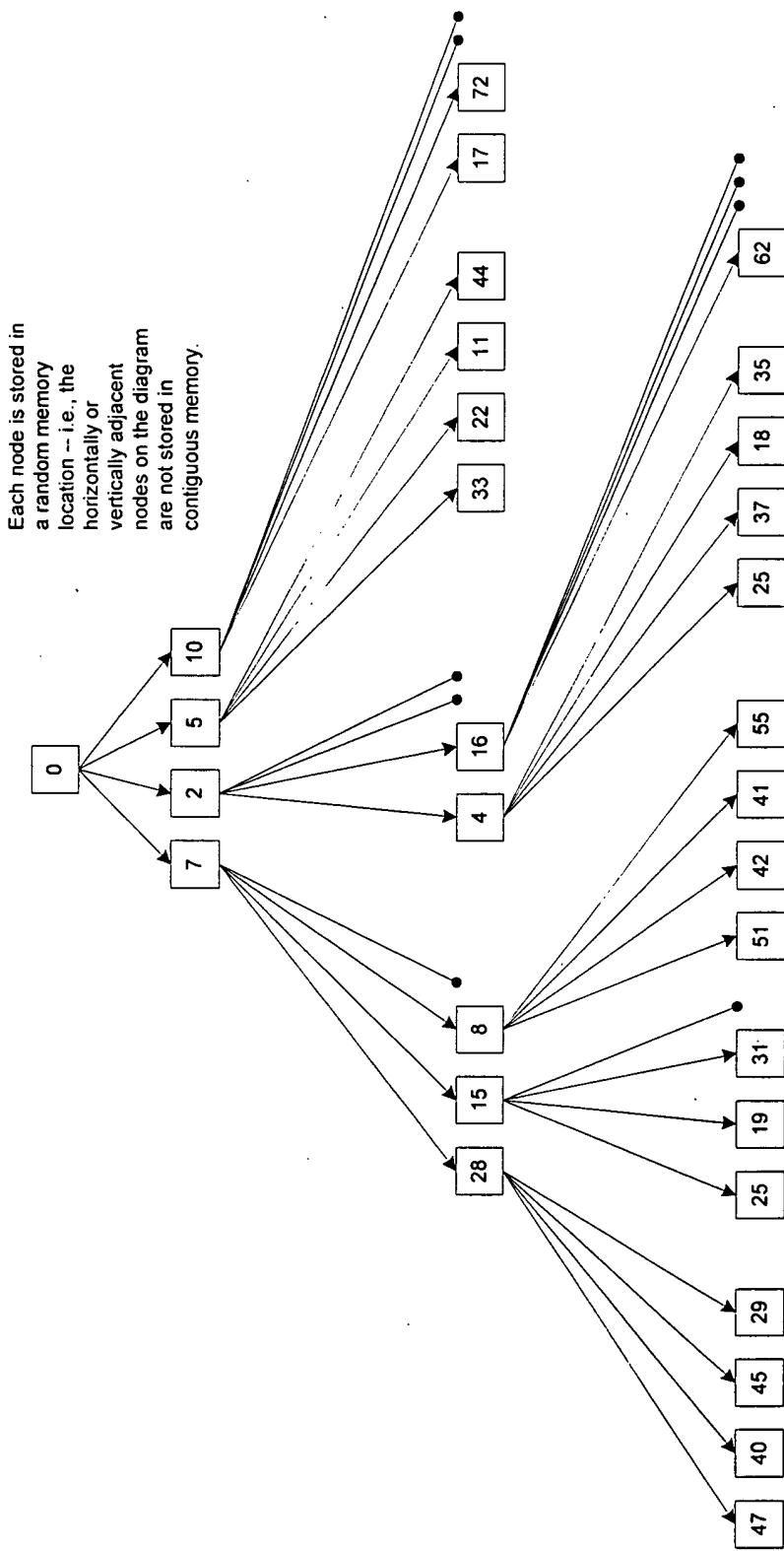


FIGURE 6

FIGURE 7

70



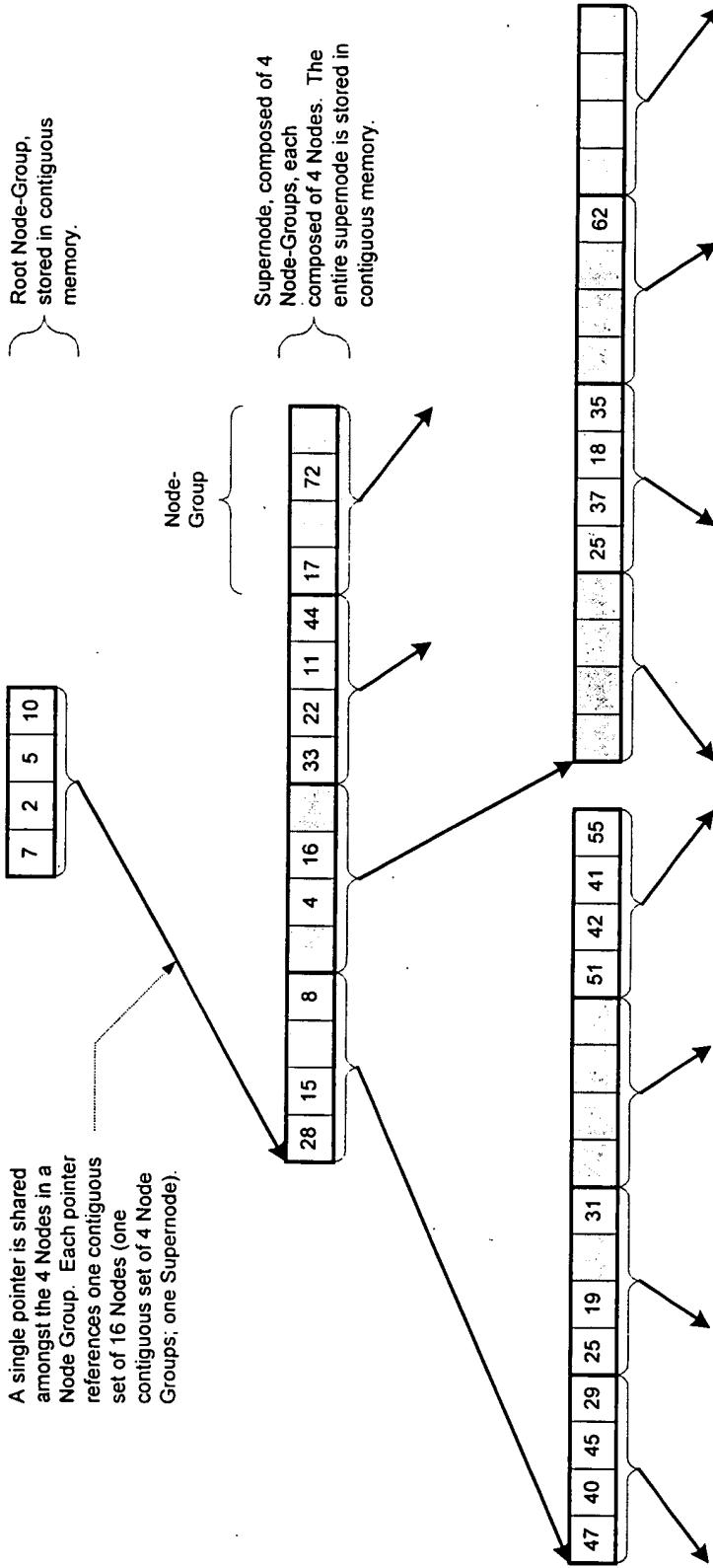


FIGURE 8

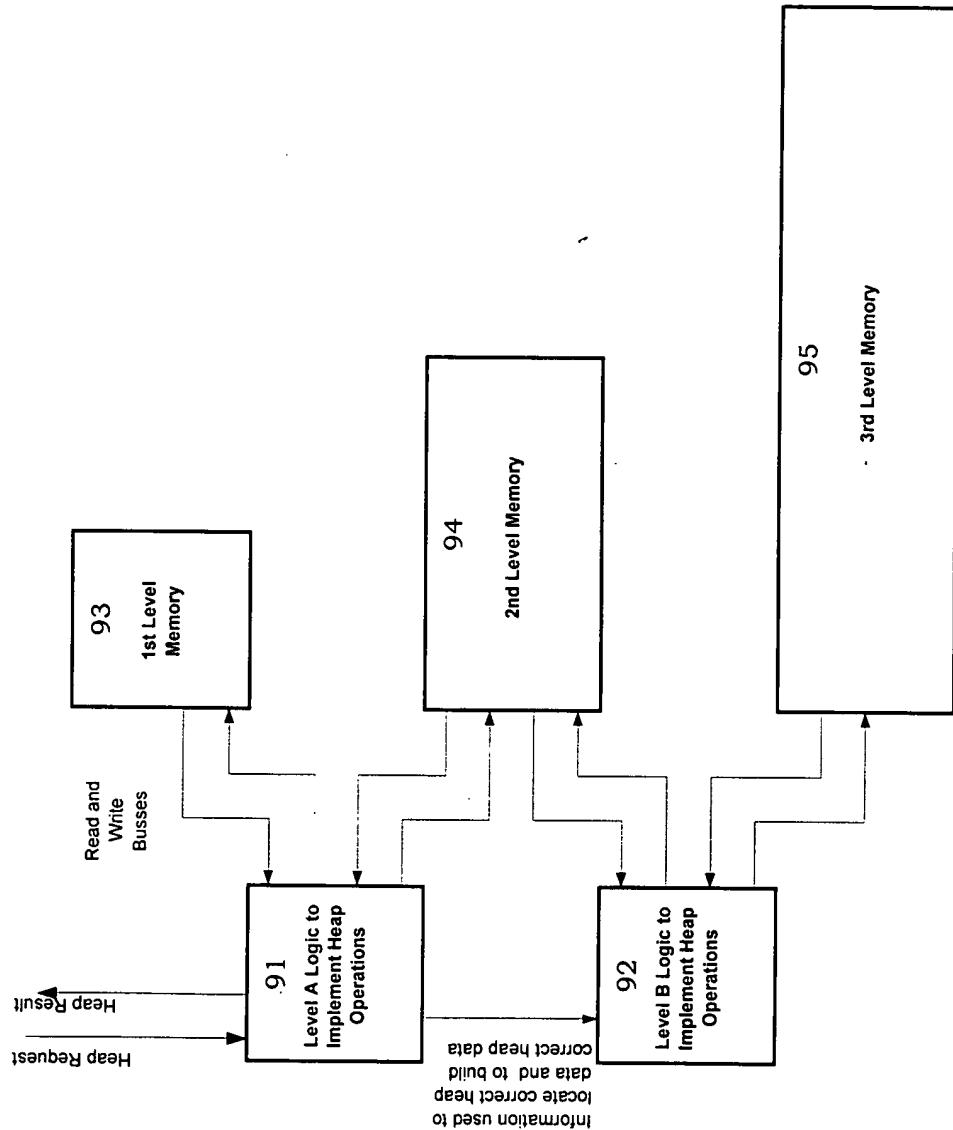


FIGURE 9

0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000

	time ----->																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Read Level 1 RAM	A					B												
Write Level 1 RAM					A													
Level A Comparisons		A	A					B										
Read Level 2 RAM	A						B											
Write Level 2 RAM						A												B
Level B Comparisons				A	A						B							B
Read Level 3 RAM		A							B									B
Write Level 3 RAM						A						B						B
Level C Comparisons					A	A						B						B
Read Level 4 RAM						A				B								B
Write Level 4 RAM							A											B

FIGURE 10

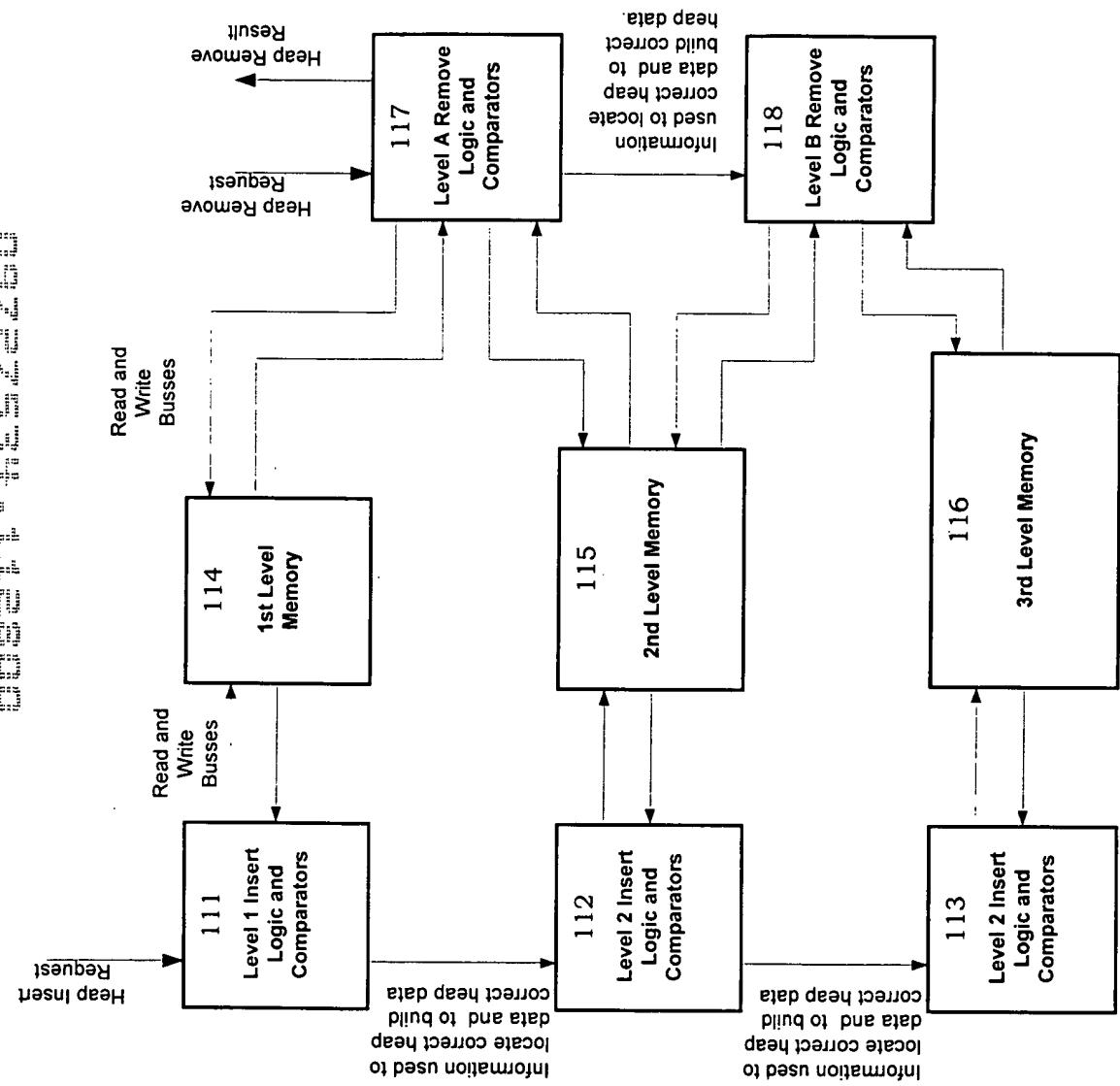


FIGURE 11

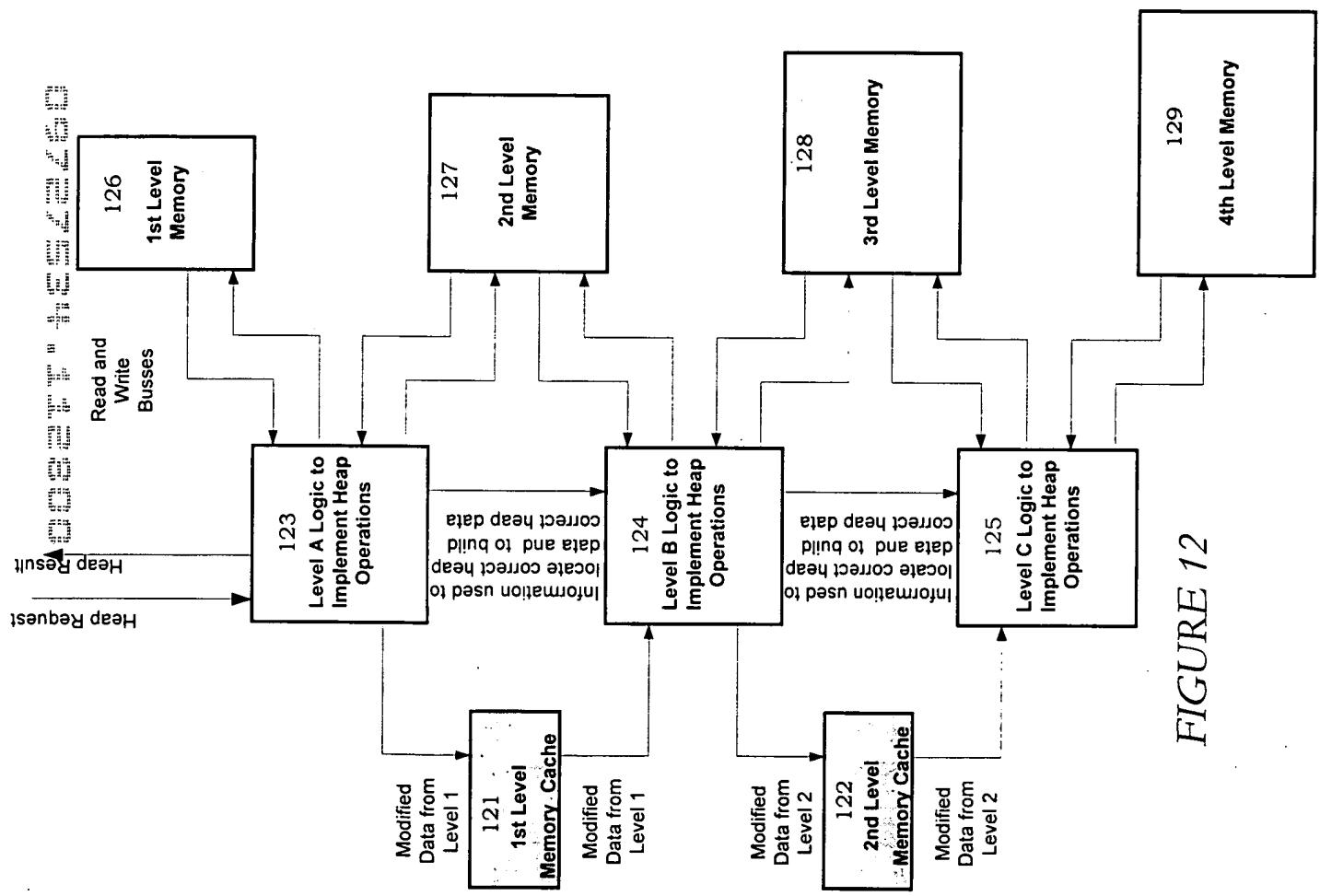


FIGURE 12

	time				
Read Level 1 RAM	A	B	C	D	E
Write Level 1 RAM		B	C	D	E
Level A Comparisons	A	A	B	C	D
Read Level 2 RAM	A	B	C	D	E
Write Level 2 RAM		B	C	D	E
Level B Comparisons	A	A	B	C	D
Read Level 3 RAM	A	B	C	D	E
Write Level 3 RAM		B	C	D	E
Level C Comparisons	A	A	B	C	D
Read Level 4 RAM	A	B	C	D	E
Write Level 4 RAM		A	B	C	D

Annotations:

- I. The 2nd request (B) starts to read from level 1 memory. The 1st request (A) starts to modify the data that it read from level one. Thus, if request B reads from the same location as request A, request B will get the old (stale), unmodified data and produce the wrong result.
- II. Once request A has finished modifying the data that it read, it can write it back. However, it must also cache the data so that when B starts to modify the data that B read, B can discard the data it read and use the current information in the cache instead.
- III. Request B checks the cache before it modifies the data that it read. If the cache indicates that B is operating on the same memory location in level 1 that request A just operated on, B uses the contents of the cache.

FIGURE 13